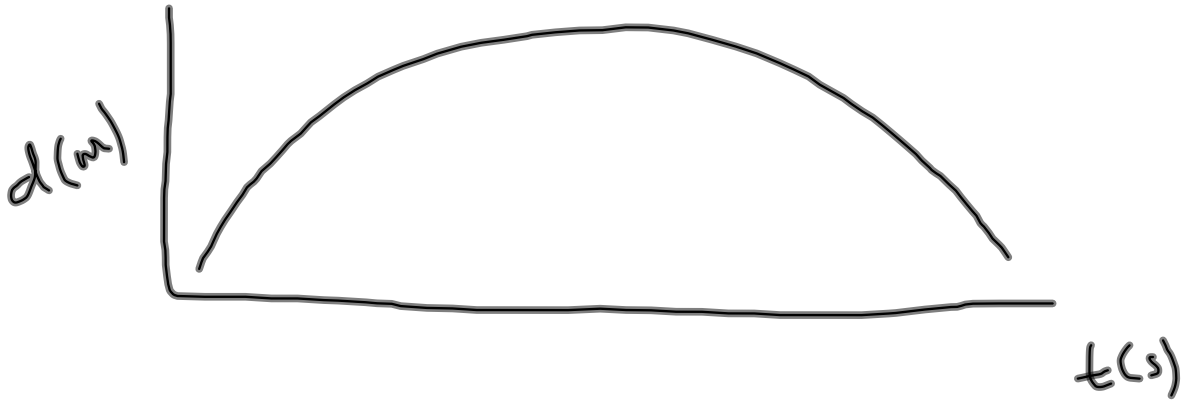
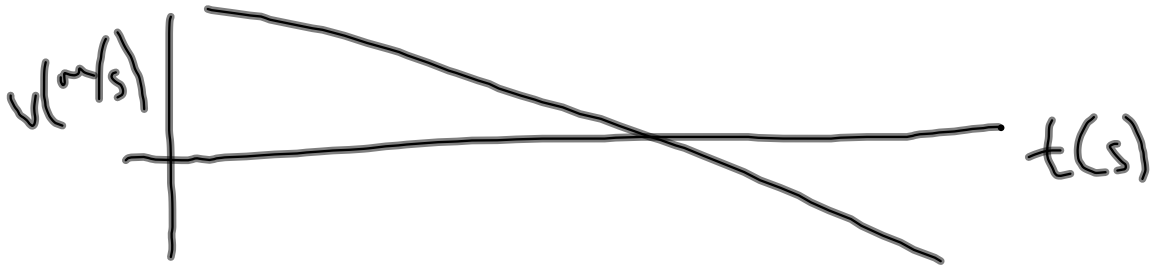
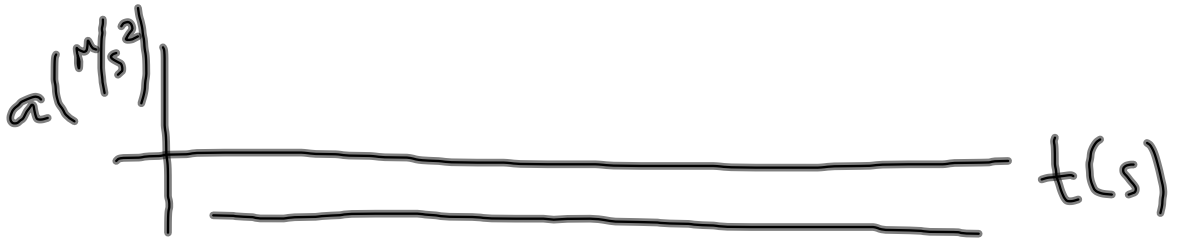
Test Topics:

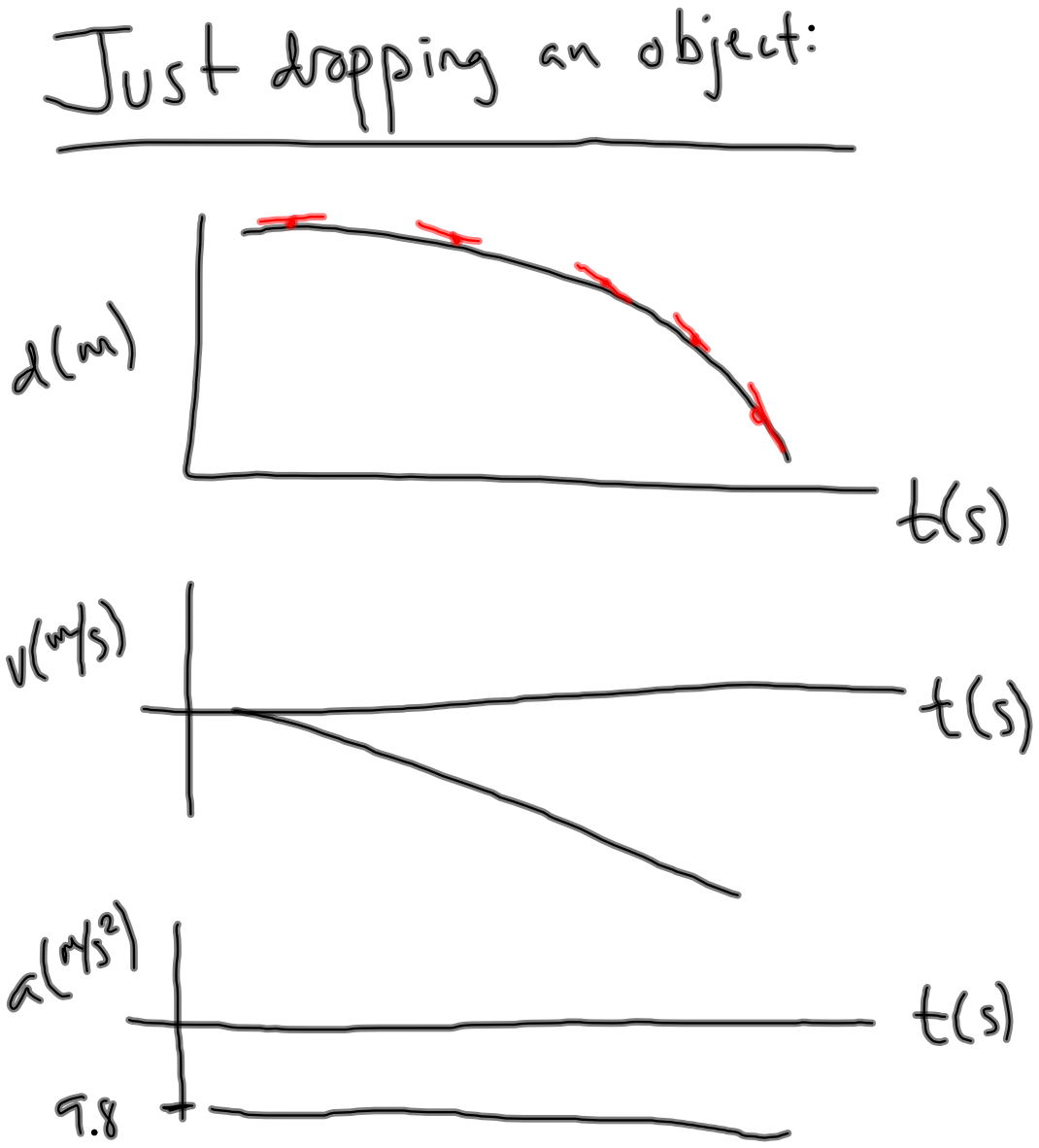
- Graphing
- Problems
  - 1-d x-direction
  - 1-d y-direction (free-fall)
- Multiple-Choice

Graph of object rising and falling:








Just dropping an object:
d(m)
t(s)
v(m/s)
t(s)
a(m/s²)
t(s)
9.8

Variables in this unit:

V_i → initial velocity vector m/s

a → acceleration vector m/s^2

Δx → displacement (in x-direction) vector m

t → time scalar s

V_f → final velocity vector m/s

Δy → displacement (in y-direction) vector m

speed → scalar m/s

distance → scalar m

A person throws a ball upwards at 10 m/s.

a) How high does it travel?

b) How long does it take to reach the highest point?

a) ↑+ $V_{iy} = 10\ m/s$ $V_{fy} = 0\ m/s$

$a_g = -9.8\ m/s^2$ $\Delta y = ?$

$V_{fy}^2 = V_{iy}^2 + 2a_g\Delta y$

$$\Delta y = \frac{-V_{iy}^2}{2a_g}$$

$$= \frac{-(10\ m/s)^2}{2(-9.8\ m/s^2)}$$

$$= 5.1\ m$$

b) $V_{fy} = 0\ m/s$ $V_{iy} = 10\ m/s$ $a_g = -9.8\ m/s^2$

$t = ?$

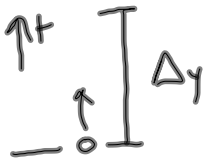
$V_{fy} = V_{iy} + a_g t$

$$t = \frac{-V_{iy}}{a_g}$$

$$= \frac{-10\ m/s}{-9.8\ m/s^2}$$

$$= 1.02\ s$$

A person standing on a balcony at 10 m throws a ball upwards at a velocity of 8 m/s.
a) How high does the object go above the 10 m starting point?
b) How long does it take for the ball to hit the ground?



a) $v_{fy} = 0\ m/s$ $v_{iy} = 8\ m/s$

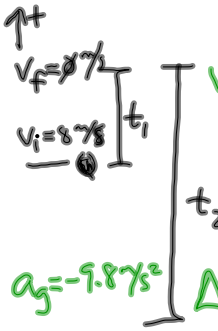
$a_g = -9.8\ m/s^2$ $\Delta y = ?$

$$v_{fy}^2 = v_{iy}^2 + 2a_g\Delta y$$

$$\Delta y = \frac{-v_{iy}^2}{2a_g}$$

$$= 3.27\ m$$

b) total time = time to top + time to the ground



$v_i = 0\ m/s$ $v_{fy} = v_{iy} + a_g t_1$

$$t_1 = -\frac{v_{iy}}{a_g} = 0.82\ s$$

$\Delta y = 10\ m + 3.27\ m$

$= 13.27\ m$

$$\Delta y = v_{iy} t + \frac{1}{2} a_g t^2$$

$$t = \sqrt{\frac{2\Delta y}{a_g}}$$

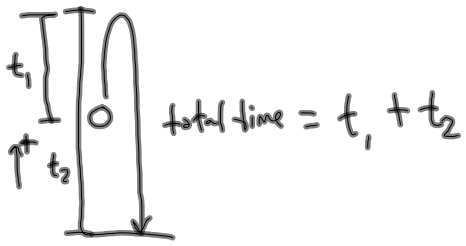
$$= \sqrt{\frac{2(-13.27\ m)}{-9.8\ m/s^2}}$$

$$= 1.65\ s$$

$$\text{total time} = t_1 + t_2$$

$$= 0.82\ s + 1.65\ s$$

Jason again throws the volleyball upwards at 2 m/s from 2 m. What is the total time that it takes for the ball to hit the ground?



1) $V_{iy} = 2\ m/s \quad V_{fy} = 0\ m/s \quad a_g = -9.8\ m/s^2$

$V_{fy} = V_{iy} + a_g t$

$t = \frac{-V_{iy}}{a_g}$

$= 0.204\ s$

$\Delta y = V_{iy} t + \frac{1}{2} a_g t^2$

$= (2\ m/s)(.204\ s) + \frac{1}{2}(-9.8\ m/s^2)(.204\ s)^2$

$= 0.204\ m$

2) $V_{iy} = 0\ m/s$

$\Delta y = -2\ m - .204\ m$

$= -2.204\ m$

$\Delta y = V_{iy} t + \frac{1}{2} a_g t^2$

$t = \sqrt{\frac{2\Delta y}{a_g}}$

$= \sqrt{\frac{2(-2.204\ m)}{-9.8\ m/s^2}}$

$= 0.671\ s$

total time $= t_1 + t_2$

$= .204\ s + .671\ s$

$= .875\ s$